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AN ECONOMIC INQUIRY INTO THE CHARACTERISTICS AND USE OF LAND FOR PASTURE WITH SPECIAL REFERENCE TO ILLINOIS

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JAMES PUTNAM GEORGE
BY
B.S., Iowa State College, 1918
M.S., Cornell University, 1925

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ECONOMICS IN THE GRADUATE SCHOOL OF THE UNIVERSITY OF ILLINOIS, 1930

URBANA, ILLINOIS

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ABSTRACT OF THESIS

An Economic Inquiry Into the Characteristics and Use of Land for Pasture With Special Reference to Illinois

By JAMES PUTNAM GEORGE

INTRODUCTION

A pasture is a field in which animals graze on herbaceous plants. The importance of pastures as an agricultural resource is indicated by the fact that, speaking for the country as a whole, they furnish annually as much feed as all harvested roughages and concentrates combined.[1] The agricultural income from 80 per cent of the land area of the United States is derived principally from grazing. Nevertheless, the attention pastures have hitherto received at the hands both of farmers and of investigators is not at all in proportion to their importance. Neglect and abusive treatment of pastures have characterized American agriculture from its early beginnings. The very abundance of this vast natural resource has obscured its economic significance.

Developments in recent times have tended to make pasturing a more economic use of land than formerly. Of first importance, perhaps, is the decline in land values following the boom incident to the World War. This has meant that many acres of land have become submarginal for crop production. Just what is the best use to which this land may be put is a problem confronting Corn Belt as well as other farmers. It was said in 1925 that the range country of the West had about reached its capacity so far as the rearing of stocker and feeder cattle was concerned.[2] Any increase in beef production which might be expected to come from improved methods of range management was predicted to have but little if any effect upon the future price of beef. The factor limiting the productivity of range pastures is the amount and distribution of the rainfall. Still another check upon the expansion of the beef industry in the West is the marked increase in the numbers of sheep on the range. This has been the result of continued favorable prices for mutton and wool.[3] Much dry land in the West was

[1] Piper, C. V. Forage plants and their culture, p. vii, 1924.
[2] Carrier, Lyman. Article entitled Pastures, Book of Rural Life, p. 4180, 1925.
[3] Mumford, H. W. The Agricultural Outlook, p. 16, 1929.

broken up and put into wheat as an emergency measure during the war. The beef output from the range states was still further reduced as a consequence.

There have been many forces at work to give farmers in Illinois and adjacent Corn Belt states a differential advantage in competition with the ranchers of the West. Among these may be mentioned high freight rates on live animals and on animal products and an increased public demand for young beef. High freight rates on live animals have resulted in an increase in the cost of bringing in thin cattle for fattening and this in turn has increased the comparative advantage of local production. The organization of cooperative shipping associations among livestock producers in the Corn Belt has given the breeding and rearing of calves an impetus. This is because cattle shipped in less-than-carload lots may now be marketed at no extra expense to the shipper. There has been a scarcity of good feeding steers on the livestock markets during the spring and summer months. This condition has become more and more accentuated with the passage of time. The solution of this problem rests with the farmers. It may be met by an increase in the numbers of beef breeding herds on farms and by an increased tendency on the part of Corn Belt feeders to grow out their own stocker cattle rather than to continue to depend upon the uncertain supply from the West. A factor of no small importance in this connection would be the more extensive use of rotated pasture, corn silage, and other rough feed on farms.

METHODS OF DATA COLLECTION

In investigating land utilization on Illinois farms, data from five sources were brought together.

1. **Illinois Crop Reporting Service Inquiry.** On September 10, 1929, the Federal-State Crop Reporting Service (the Illinois State Department of Agriculture, Springfield, and the United States Department of Agriculture, cooperating) mailed a farm pasture inquiry to correspondents over the State. The object was to secure information not only recent but more complete than that heretofore existing with reference to farm land used as pasture.

2. **Personal Farm Survey.** During August, 1929, the writer visited 68 farms in four different parts of the State. These farms were situated in McHenry, Schuyler, Champaign, and Effingham counties. So far as was practicable, information was gathered from farms composing one common school district in each of these counties.

3. **Vocational Agriculture Students.** In September, 1929, questionnaires were mailed to teachers of vocational agriculture in widely scattered parts of the State and distributed by them among the students in their classes.

4. **Farm Bureau-Farm Management Service Data.** The University of Illinois, Department of Farm Organization and Management, in cooperation with County Farm Bureaus, has for several years conducted an intensive study of the principles governing successful farm organization on a considerable number of farms located in the counties of Tazewell, McLean, Woodford, and Livingston. Summary sheets giving rather complete records of the business transactions and operation of these farms were accessible and in part served as a basis for the present study.

5. **United States Census Data.** Statistical information was obtained from the United States Census of Agriculture and served as a basis for comparison with information gathered from other sources.

USE OF LAND ON SELECTED ILLINOIS FARMS, WITH SPECIAL REFERENCE TO PASTURES, PART I.

The following table reports the results of land utilization studies on 353 Illinois farms:

Table 1. Apportionment of Farm Land Among Each of its Major Uses, Information From Four Sources, Illinois, 1925 and 1928.

	Group A. Illinois Crop Reporting Service	Group B* Farms Reported by Operators Interviewed by the Writer				Group C. Vocational Agriculture Students	Group D. Farm Bureau-Farm Management Service
		Co. 1	Co. 2	Co. 3	Co. 4		
Year	1928	1928	1928	1928	1928	1928	1925
Number of farms....	68	15	16	20	14	25	195
	%	%	%	%	%	%	%
Proportion of all farm land in							
Crops	60	50	60	86	71	81	87
Pasture	28	28	19	10	18	14	9
Woods	—	11	12	—	5	—	—
Other	12	11	9	4	6	5	4
	100	100	100	100	100	100	100
Average acres	244	168	144	208	184	172	228

*County 1, McHenry; County 2, Schuyler; County 3, Champaign; and County 4, Effingham.

The Farm Bureau-Farm Management Service farms and the Champaign County farms reported in the above table, fall within what is known as Farming-Type Area 4. This is the cash grain area of east central Illinois. It is to be noted that the proportion of farm land in pasture and other uses is relatively low in this section of the state. The Illinois Crop Reporting Service farms and the farms of vocational agriculture students are more nearly representative of state-wide conditions. McHenry County, in the dairy section of northern Illinois, stands high in the ratio of pasture land to land in use for other purposes.

Table 2. Apportionment of Farm Land Among Each of Its Major Uses and Average Acreage Per Farm, United States, East North Central States and Illinois, United States Census, 1910 and 1925, and Farms Reported by Operators Interviewed by Writer, (Group B,) 1928, and by Farm Bureau-Farm Management Service, (Group D,) Illinois, 1925.

Proportion of farm area in crops, pasture and woods:

	United States		East North Central States		Illinois						
					State as a Whole		Group B.*				Group D.**
							Co. 1	Co. 2	Co. 3	Co. 4	
Year	1925	1910	1925	1910	1925	1910		1928			1925
	%	%	%	%	%	%	%	%	%	%	%
Crops	43	36	57	52	69	63	66	56	84	63	81
Pasture	44	33	32	29	24	24	27	38	13	28	16
Woods	7	—	4	—	2	—	—	2	—	5	—
Other	6	31	7	19	5	13	7	4	3	4	3
	100	100	100	100	100	100	100	100	100	100	100
Average size of farms (acres)	145	138	107	105	136	129	129	160	172	121	228

*County 1, McHenry; County 2, Schuyler; County 3, Champaign; and County 4, Effingham. Group B refers to the 65 farms surveyed by the writer.

**Group D refers to the 195 farms for which information was collected by the Farm Bureau-Farm-Management Service.

Data from the Census presented in Table 2 agree closely with information from other sources. Tables 1 and 2 may remove all doubt that in the areas concerned crop production and pasture are the major uses of farm land, at least when measured in acreage. While for Illinois and the East North Central Division pasture acreage ranked second to crop acreage, for the United States (both periods, 1925 and 1910) they were of practically equal importance.

PASTURE AND THE PROBLEM OF LAND CLASSIFICATION

The pasturing of land sometimes introduces complexity when it comes to its classification. Dual uses of land may lead to confusion unless the problem in each instance be handled with care. The presence of rotation pastures on farms suggests that part of the land which is in use for crops some years is in use for pasture in others. The second growth of hayfields, small grain stubble, cornstalk, and cornfields which are utilized for pasture imply the use of identical land for crops and for pasture the same year; while woods pasture means the simultaneous use of land for timber production and for pasture. One year with another, the area of crop land in Illinois and the United States, which, in addition to producing a crop is pastured, is probably in excess of the crop land not so used. Moreover, the area of timber land annually pastured is greater than that never pastured.[4] The separation of land in accordance with its use, therefore, must be accomplished, if at all, on the basis of its most important function. Net cash returns must serve as our index of value or relative importance and, since this is true, land which is cropped and pastured the same season is usually classified as crop land. In like manner, wood lots which furnish pasture are classified as timber. The use of such lands for pasture is distinctly incidental.

PASTURES AS A SOURCE OF ANIMAL FEED[5]

"Pastures furnish not only the cheapest feed for live stock, but more than half of all the feed consumed by the live stock of this country. A study of the situation shows that wherever live stock raisers are continuously prosperous, the foundation of this prosperity is pastures." (The South)[6]

"Pastures the cheapest feed . . . the Iowa Experiment Station conducted a year's experiment . . . it was learned that it cost

[4]The United States Census, 1925, gives the following information concerning the areas of woodland pasture and of woodland not pastured on farms for Illinois, the East North Central Division, and the nation.

	Woodland pasture (acres)	Woodland not pastured (acres)
Illinois	1,896,966	738,642
East North Central Division	12,468,884	4,661,087
United States	76,703,946	67,900,246

[5]The author assumes no responsibility for the nine statements quoted at the beginning of this section, and is trying to prove nothing through their use. His object is merely to illustrate the views of certain writers concerning the economy of pastures.

[6]Profitable Permanent Pastures for the Southeast, page 3, Feb., 1925. A pamphlet issued by the Agricultural Department of the Central of Georgia Railway Company.

$1.98 to produce 100 pounds of milk during the pasture season, $3.00 during the part pasture season, and $4.03 during the winter season." (Iowa)[7]

"To produce 34 cents worth of milk on pasture costs 9.7 cents for feed. To produce the same amount of milk with winter feed costs 38 cents." (New York)[8]

"Cows on grass produce more milk at from 1/5 to 1/10 the cost of barn feeding." (New York)[9]

"Fattening cattle, which would cost 20 cents on a ration of grain and roughage, costs only three or four cents a pound on pasture land, and a cow pastured at a cost of three to five cents a day will give as much milk as when fed on grain and hay at three to four times the cost." (General)[10]

"Recent studies show that the gains made by cattle on pasture cost, in general, only one-half to one-fourth as much as those made when the animals are fed crops . . . (General)[11]

". . . pasture is the cheapest form of animal feeding . . ."[12] (General)

"With minor exceptions, meadows and pastures are the most economical source of farm income." (Pennsylvania)[13]

"Labor economy of pasture feeding is emphasized by the fact that to produce one ton of digestible crude protein in the grain rotation involves a labor cost of approximately $178.00 as compared with $2.82 on pasture." (Pennsylvania)[14]

In any comprehensive review of the literature of the subject one is confronted with expressions of which the above nine are typical. It is not the intention of the writer at this point to appraise these statements or to attempt their verification. He considers it within his province rather to point out those facts inherent in the pasturing of land which tend to make pasture a cheap source of feed for farm animals.

[7]Practical Permanent Pastures, page 19. A pamphlet issued by the Agricultural Department of the Central of Georgia Railway Company.

[8]Wilkins, F. S., Article entitled There's Big Money in Good Pastures, Prairie Farmer, page 6, April, 1930.

[9]Warren, G. F., White, Paul J., and Roberts, I. B., Pastures in New York, New York Expt. Sta. Bul., 280, page 355, July, 1910.

[10]Compton's Pictured Cyclopedia, Vol. 3, page 1503, 1922.

[11]Piper, C. V., Vinall, H. N., Oakley, R. A., Carrier, Lyman, Bureau of Plant Industry; Baker, O. E., Cotton, J. S., Juve, O. A., Bradshaw, Nettie P., Bureau of Agricultural Economics; Sheets, E. W. and March, C. D., Bureau of Animal Industry; Barnes, W. C., Forest Service; and Bell, W. B., Bureau of Biological Survey. Our Forage Resources U. S. D. A. Yearbook 1923, Separate 895, page 365.

[12]Howe, F. W. Farm Economics, page 124, 1926.

[13]Gardner, Frank, Farm Crops, page 132, 1918.

[14]White, J. W., and Holben, F. J., Kentucky Blue Grass Pastures, Pa. Expt. Sta. Bul. 195, page 24, May, 1925.

Pastures in the main are composed of lands of secondary or inferior quality. Because of the low valuation placed upon them taxes and interest on the money invested in the land are also relatively low. Expenditures for pasture maintenance and improvement as these lands are usually cared for in America are almost negligible. Livestock on pasture requires a minimum of attention on the part of the farmer. The animals do their own harvesting, the farmer being relieved of this item of expense so common in the cultivation of field crops. Because of their high proportion of protein materials in readily digestible form immature pasture plants partake more of the nature of watery protein-rich concentrates than they do of roughage. Animal parasites in the case of hogs and sheep, for instance, are pretty largely avoided through the use of temporary pastures and forage crops. Other feeds consumed by farm animals are rendered more effective in the productive process when the animals are on grass. The explanation of this physiological effect lies in the presence of vitamins in pasture herbage. Vitamin D assists in the assimilation of mineral elements. It is particularly important in the metabolism of the dairy cow, because it enables this class of farm animals to build up their reserve of phosphorus and calcium. These bone forming constituents enter also largely into milk production and are drawn upon during the long period of dry feeding. Even the hog which is not ordinarily looked upon as a grazing animal shows a higher economic return from feeding operations when judicious use is made of forage and temporary pasture crops. Ultra violet rays are health giving factors associated with pasture. Systems of farm cost accounting fail to credit pasture with many of the indirect effects which come from its use and which are difficult or impossible of expression in economic terms. Finally the gross returns from this method of land utilization are less than from cultivated fields, but the net return may be as great, or under some circumstances perhaps greater. There is a certainty of income derived from the use of land for pasture, which is to be found in few lines of agricultural production.

ECONOMIC RETURNS IN THE USE OF LAND AS PASTURE

An analytical study was made of the use of pasture by different classes of farm animals in the counties of Woodford, McLean, Tazewell, and Livingston for the period 1925 to 1928, inclusive. Pasturage was estimated to be worth ten cents per day per animal unit pastured.

On this basis of economic reasoning the sustenance furnished 6,649 farm work horses represented on the average from 21 to 29 per cent of the value of the total feed consumed by this class of farm stock. There was an average of 178 farms reporting throughout the four year period.

In the case of cattle pasture furnished on the average from 28 to nearly 30 per cent of the value of all feed consumed. Included in this study were 5,796 head of beef cattle, 3,539 head of dairy cattle, and heifers and calves equivalent to 1,989 cattle units. The average number of reporting farms was 175.

For hogs the monetary equivalent of pasture days was on the average from four to six per cent of the value of all feed consumed. Because of its favorable effect upon animal nutrition and because of the part it plays in swine sanitation the economic value of pasture to the pork producer must be considerably greater than here indicated. If the many indirect effects of pasture be given their full weight pasture for hogs is probably not much less important than in the case of some other classes of farm stock. The average number of farms reporting was 159. The study covered mature hogs and pigs equal to 6,673 animal units.

Pasture contributed from 25 to over 50 per cent of the value of all feed consumed by sheep on the farms studied. Apparently it is more of a factor in mutton and wool production than in the production of any other animal product. Included within the scope of this study were ewes and mature sheep equivalent to 798 animal units and lambs equivalent to 270 animal units. The average number of farms for each of the four years was 48. Feeder sheep are usually purchased and fed out during the winter. From the number of pasture days reported, however, there must have been a considerable number of head on hand throughout the pasture season.

PASTURED FARM LAND SUBDIVIDED IN ORDER TO ILLUSTRATE THE CONTRIBUTION, IN POINT OF ACREAGE, OF EACH OF THE SEVERAL KINDS OF PASTURE

The major uses of land on Illinois farms have been considered. At this point it is desirable to make clear the relationship not only of pasture in general to other farm enterprises, but also of the several kinds of pasture to the total area of farm land annually so used.

Table 3. Percentage of All Grazed Land in Various Pasture Uses as Computed or as Estimated, Illinois, 1925 and 1928.*

	Group A. Illinois Crop Reporting Service	Group B. Data reported by operators interviewed by writer.	Group C. Vocational agricultural students	Group D. Farm Bureau-Farm Management Service			
Year	1928	1928	1928	1928	1927	1926	1925
Number of farms....	75	65	25	150	194	194	195
	%	%	%		%		
Regular pasture:							
Permanent pasture tillable	26	14	22	7	8	9	10
Permanent pasture, non-tillable	11	14	18	12	11	11	11
Rotated pasture....	11	6	19	16	19	18	18
Woods pasture.....	11	12	11	—	—	—	—
Crop land pastured:							
Aftermath pasture..	7	9	1	4	4	4	6
Grain stubble pasture	11	17	10	31	21	24	22
Corn stalk pasture	30	26	18	29	31	33	31
Mature corn pastured off	—	3	1	1	6	1	1
Total	100	100	100	100	100	100	100
Proportion of land pastured to total farm land	59	54	40	47	43	42	42

*See Appendix A, Tables 1 and 2, pages 35 and 36, respectively.

It will be noted that a very considerable proportion of all land on farms studied furnished pasturage at one time or another during the 1928 grazing season. For the 75 farms reported in Group A the amount of land thus used was equivalent to 127 acres per farm. In the interpretation of these figures, however, it must be borne in mind that the fields to which stock had access and which were reported as having been pastured were not necessarily stocked anywhere near their capacity. The degree to which dependence

was placed upon pasturage for the sustenance of stock and the intensity of pasturing were not here emphasized.

REGULAR PASTURE

Regular pasture is meant to include only that farm land which is fenced and used to furnish pasturage to stock throughout the entire pasture season. It refers, therefore, to all land in permanent pasture, whether tillable or non-tillable, to rotation pasture, to woods pasture, and to special hog pasture. On the farms reporting to the Illinois Crop Reporting Service the area of permanent pasture, tillable, was more than twice as large as any other kind of regular pasture. The area in permanent pasture, non-tillable, in woods pasture, and in rotation pasture were all of equal importance.

The area of land in the farms—whose operators were interviewed by the writer—occupied, respectively, by permanent pasture, tillable, and by permanent pasture, non-tillable, were equal in extent. Rotation pasture was relatively insignificant while woods pasture stood next after the two classes of permanent pasture. Compared with the other groups, woods pasture on these surveyed farms constituted a much larger proportionate share of all pasture.

Permanent pasture, tillable, took first place on the farms of vocational agriculture students. Relatively large use, however, was made of permanent pasture, non-tillable, and of rotation pasture. Woodlands on these farms were also used extensively as a source of pasturage. Farms reported by the Farm Bureau-Farm Management Service made no report of woods pasture. It is a noteworthy fact that these farms depended to a lesser degree on permanent pasture, tillable, and to a greater extent on permanent pasture, non-tillable, than did farms in any other group.

CROP-LAND PASTURE

Crop-land pasture includes the aftermath of hay meadows, stubble fields, cornstalks, and mature corn which is hogged off. Some writers use the term "fall pasture" in preference to the term "crop-land pasture."

Cornstalk pasture and small-grain stubble were of major importance on all farms studied and reported in Table 3, while aftermath pasture and mature corn pastured off were only of minor significance. Farm Bureau-Farm Management Service farms, being situated in the cash-grain area of east-central Illinois, showed evidence of having a somewhat larger proportion of small-grain

stubble and of cornstalk pasture than did the farms of other groups.

DIFFERENT KINDS OF PASTURE AND THEIR SIGNIFICANCE

The different kinds of pasture on any particular farm or in any community are useful indices as to the type of farming followed. In sections of the State with large amounts of tillable land and where cash grain is the principal farm enterprise, one finds that the proportion of cornstalk pasture and of small-grain stubble pasture runs higher than in other areas. Here also rotation pasture is relatively important. In so far as the classification of pasture is indicative of the quality of each respective kind, it may serve as a criterion as to the class of livestock kept. As a general principle, as the quality of pasturage increases, the use of the pasture is restricted to the more highly productive classes of farm animals.

LAND TENURE AND THE PROPORTION OF FARM LAND IN PASTURE

The influence of the system of land tenure in relation to land utilization, with special reference to pasture, has been studied. As a full owner the farm operator owns all the land he farms; as a full tenant he secures the use of all of it by contracting for it under lease, either cash or share or a combination of the two; or as a part owner he may hold part of it under ownership and part under lease. These various distinctions and their relation to proportion of farm land in pasture are brought out below.

Table 4. Full Owners, Part Owners, and Full Tenants, Exclusive of Those Combining Cash and Share Tendency, 240 farms, Illinois, 1928.

	Full owners		Part owners		Full tenants (exclusive of those combining cash and share rent).			
					Cash only		Share only	
	Group* A	Groups** B & C	Group A	Groups B & C	Group A	Groups B & C	Group A	Groups B & C
Number of farms..	86	49	35	22	12	6	13	17
Mean average percentage of farm land Held under each system of tenure	100	100	64	87	100	100	100	100
In regular pasture	22	30	16	21	31	27	18	28

*Group A referring to the Illinois Crop Reporting Service Farms.

**Groups B & C referring, respectively, to farms surveyed by the writer and to farms of vocational agriculture students.

Under ordinary circumstances as one descends the agricultural ladder he expects to find a smaller and smaller proportion of farm land in use as pasture. This is because of the conflict of interests between the landlord on the one hand and the tenant on the other. Under most systems of land tenure it is to the advantage of the landlord for the tenant to follow a more or less intensive type of farming. Landlords tend to discourage the keeping of much land in pasture on the part of tenants. In the study reported in the preceding table, Group A farms showed full cash tenants to have a larger proportion of their farms in pasture than did full owners. The farms, however, reporting in Groups B and C showed the reverse to be the case. Full cash tenant farms in Group A had on the average 13 per cent more of their land in pasture than the full share tenant farms. So far as Groups B and C were concerned the full cash tenant and the full share tenant farms were nearly, although not quite, equal in the per cent of land in pasture. In both groups the part cash tenant farms had a larger proportion of their land in pasture compared to the part share tenant farms. The following conclusions seem warranted: (a) There is some positive correlation between the percentage of farm land owned by operator and the percentage of farm land in pasture. (b) There is an even stronger positive correlation between percentage of farm land held under cash lease and percentage of farm land in pasture. Two possible explanations suggest themselves: first, on share rented farms land kept permanently in pasture is usually paid for on the cash basis; second, the more complete control which the farmer has over his farming operations the greater the tendency evidently becomes for him to keep a larger proportion of his land in pasture.

USE OF LAND ON SELECTED ILLINOIS FARMS, WITH SPECIAL REFERENCE TO PASTURE, PART II.

The study of land utilization for pasture purposes thus far has been concerned principally in getting a perspective of the state as a whole. Only general aspects of the problem have received consideration. At this point the study will concern itself with the apportionment of pasture land among its various uses.

Cornstalk pasture, so far as the apportionment of farm land used for this purpose was concerned, stood first on these 75 farms. Permanent pasture, tillable, came second, while permanent pasture,

Table 5. Apportionment of Pasture Land Among Each of Its Several Kinds, by Farming-Type Areas'* State Crop Reporting Service, Illinois, 1928.**

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
Number of farms	9	8	8	19	9	5	7	10
	%	%	%	%	%	%	%	%
Regular pasture:								
Permanent pasture, tillable	19	12	8	15	46	27	57	32
Permanent pasture, non-tillable	16	8	13	5	15	24	14	0
Rotated pasture	8	16	9	10	8	16	4	0
Woods pasture	5	0	10	1	5	1	4	9
Special hog pasture	3	1	4	2	1	(1)	1	1
Crop-land pastured:								
Aftermath pasture	11	10	3	4	2	3	10	29
Small-grain stubble pasture	15	6	20	21	1	3	1	8
Cornstalk pasture	23	47	33	41	22	26	9	21
Seedling pasture	0	0	0	1	0	0	0	0
	100	100	100	100	100	100	100	100
Proportion of farm land pastured	53%	65%	82%	59%	73%	45%	37%	59%

*Referring to the farming-type areas of which eight have been mapped by the Department of Farm Organization and Management, University of Illinois.

**See Appendix A, Tables 3 and 4, pages 36 and 37, respectively.

non-tillable, and small grain stubble pasture were about equal in importance from the standpoint of acreage. There was not great amount of difference between the proportion of land in rotation pasture and that in aftermath pasture. Seedling pasture or small grains used for pasture only was of miner significance.

The proportion of farm land pastured varied more or less during the season in different farming type areas from 37 per cent to nearly 82 per cent. The mean average for all the farms was about 60 per cent. Several of these areas show an especially large per cent of farm land which was pastured. There is no assurance that these farms are typical of farming conditions generally in their respective areas. The number of farms in each case is relatively small. For these reasons Table 5 should be interpreted merely as a preliminary study.

ROTATION PASTURES

Rotation pastures are short-lay grasslands, usually of not more than two or three years duration. Fallow land pastures are sometimes considered in this category, although best usage probably does not approve of their being so included. A good example of rotated pasture would be the pasturing of a mixed timothy and

clover meadow a year or two before breaking it up for corn. Still another is that of sweet clover, frequently used on account of its soil building and heavy yielding pasture qualities. In the grazing of sweet clover the exercise of good judgment is essential. Otherwise the farmer may very easily get into difficulties. The possibilities of rotated pasture on tillable land apparently have not as yet been fully appreciated. Statistical data relative to rotation pastures in America are fragmentary and very unsatisfactory.

ROTATION PASTURE VERSUS PERMANENT PASTURE

Permanent pasture reduces the amount of fencing necessary and simplifies the labor problem. Good permanent pastures are ordinarily provided with feed bunks or racks, a water supply, and shade. This means a saving in the expenditure of human energy. In regions where systems of mixed grain and livestock farming prevail and where it is not requisite that the land be pastured closely rotation pastures are highly desirable. This is particularly true in the case of farms composed chiefly of tillable land. Rotation pasture allows opportunity for the distribution of manure at periodic intervals over the entire farm. It thus contributes to fertility maintenance at low cost. The organic matter and fertilizing elements contained in the roots and residue of the pasture plants themselves tend further to increase the productive power of the soil. It is of course true that a rotation pasture does not form a dense turf or sod and will not resist heavy pasturing and trampling by stock so well as will pastures consisting of long-lived species which propagate by means of stolons and rhizomes. Rotation patsures have been known to fail when most badly needed, whereas permanent pastures are usually to be relied upon at least to some extent even when affected by drought. Under judicious handling permanent pastures improve with age. On the other hand, the carrying capacity of a rotation pasture is greater on the average than is that of a permanent pasture. Sands and soils of sandy nature, if used for pasture at all, are best suited to use as rotation pasture. In the vicinity of large cities where land is high in price the rotation pasture assumes a more important position relative to the permanent pasture than elsewhere.

WOODLAND PASTURE

On many farms, particularly those bordering streams, some use is commonly made of woods for pasture purposes. In a prairie

state such as Illinois it is a well-known fact that timbered areas have been largely concentrated along water courses. In the classification of pasture lands the term "woods pasture" has frequently lead to confusion. The words "woods pasture" are capable of a very loose interpretation, meaning in the mind of different individuals all the way from an open pasture with a few scattered trees to a dense farm timber lot. Under these conditions reports as to the acreage of such pasture may have little definite value as to the amount of pasturage. For this reason in the pasture inquiries sent out to farmers by the Illinois Crop Reporting Service, information was called for which would make it possible to convert acres of woods pasture into its equivalent acres of open pasture. Three-hundred eighty-five acres of woods pasture on the 75 farms included in the survey were capable of furnishing about as much nutriment to farm stock as would 60 acres of open pasture. Investigators have found that pasture herbage common to wooded areas shows very little value from a nutritive standpoint.[15] Livestock running at will through a wood lot acts as a detriment to the stand of trees. In the last analysis the woods spoil the pasture and indiscriminate pasturing may reduce the value of the woods. It seems to be the usual case that farmers would gain more in the long run by keeping their stock out of the woods and by directing attention to pasture improvement.

REASONS FOR LAND BEING KEPT IN PERMANENT PASTURE

On soils of more than average quality in the more densely settled sections of the United States there is a pronounced feeling among farmers to the effect that permanent pastures should be confined to rough and broken land and to land otherwise unsuitable for crop production. To what extent Illinois farmers are actuated by this feeling in their farm practice with respect to the kind of land kept permanently in pasture has been touched upon in an earlier chapter. Inasmuch as the topography of more than half of the land in permanent pasture would permit of cultivation and inasmuch as there is within the State an undetermined amount of crop land which might well be in permanent pasture, the problem of ascertaining the underlying motives on the part of the farmers in the management of their farm lands is worthy of careful an-

[15]Welton, F. A. and Morris, V. H., Article entitled Woodland Pastures in Journal of Forestry, October, 1928.

alysis. To what extent does chance act as a determining factor in land utilization and to what extent is the farmer governed by carefully preconceived plans concerning the best use to which his land resources should be put.

Table 6. Reasons for Land Being Kept in Permanent Pasture—175 Farms, Groups A, B and C, Illinois, 1928.

	Group A 82 farmers		Groups B and C 93 farmers	
	Number of times mentioned	Per cent of total	Number of times mentioned	Per cent of total
Land in open woods	27	16	7	7
Land rough and broken	24	14	24	23
Soil washes unless kept in sod	23	14	1	1
Conditions unusually favorable for the growth of grass	17	10	12	12
Convenient, handy, and other reasons	16	9	15	15
Land too wet for cultivation	14	8	15	15
Land too steep for cultivation	12	7	5	5
Soil too poor for economic production of field crops	8	5	1	1
Land too stumpy for cultivation	7	4	8	8
Land too stony for cultivation	6	4	4	4
Land too heavy for cultivation	5	3	4	4
Soil thin and shallow with rock outcrops	4	2	3	3
Land too dry for cultivation	4	2		
Field located too distant from the barnyard	3	2		
Creek provides natural water supply			1	1
Aesthetic values			1	1
	170	100	101	100

A study of Table 6 reveals the fact that reasons of predominating importance, so far as explaining why Illinois farm land is kept permanently in pasture, include the following:

Land in open woods
Land rough and broken
Soil subject to erosion unless kept in sod
Land too wet for cultivation
Conditions unusually favorable for the growth of grass
Fields convenient and handy

Of these six reasons four are associated with conditions which render land incapable of cultivation. The remaining two may or may not be associated with such conditions. It might appear from this study that most of the pasture land on the farms furnishing the

information should be classed as non-tillable. From his knowledge of the facts, however, it is the opinion of the writer that this interpretation is not warranted. Certain factors may be operating in the same field and at the same time and thus be jointly responsible for the keeping of that particular piece of land in pasture. It is seldom that a single factor operates to the exclusion of all others. Thus it becomes difficult or impossible to show in a study of this kind the relative area of pasture land on each farm affected primarily by the action of a single factor.

Fields which are convenient and handy are often kept in permanent pasture even though they consist of good arable land. This reason is of probably greater significance than might ordinarily be suspected unless one were to study the question closely.

Both because of the need for it in the maintenance of livestock and because of the character of much of the farm land in this state, pasture is a necessary adjunct to most cropping systems. While farms with a goodly proportion of rough or wet land may be used to a certain extent in the production of wild hay, pasturage is the use to which land of this description is most usually put.

CHARACTERISTICS OF AN IDEAL PASTURE

An ideal pasture provides constant herbage throughout the grazing sesaon. It starts growth in early spring and continues in productivity until late in the fall. It yields abundantly of grasses which are nourishing and attractive to stock. In most sections of the United States as much as 1½ to 2½ acres of pasture per animal unit will be required each season, and especially is this the case where the livestock receive no supplementary feed in addition to pasturage. Better results, however, are usually obtained when sole dependence is not placed upon pasturage for sustenance. In the northeastern United States it is estimated that from 2 to 3 acres of valley pasture, or from 3 to 5 acres of hill pasture are required under ordinary circumstances for each animal unit per season.[16] A good pasture in the hill sections of West Virginia has been defined as one which will furnish abundant grass from 2½ acres for a 1,000 pound cow or steer during the grazing season.[17] Several thousand Illinois farmers were requested to place an estimate on the amount of pasture required to carry a cow and calf through the grazing season. Of the replies received to this questionnaire 8 per

[16]Myers, W. I. Lecture notes in Farm Management Course, Cornell University.
[17]Cook, I. S. West Virginia Pastures, West Virginia Expt. Sta. Bul. 177, August, 1922, page 1.

cent indicated the pasture requirement to be less than 1.5 acres, 55 per cent as much as 1.5 to 2 acres, and 37 per cent above 2 acres.[18]

ECONOMICS OF PASTURE IMPROVEMENT

What attention, if any, did permanent pastures receive during the years 1926 and 1928, inclusive? Nearly three out of five, or fifty-nine per cent of the farmers, approached with this question reported having done something towards the amelioration of pasture conditions. Twelve practices are listed in the following table with the number of times mentioned in each case. The relation of each practice to the other eleven based upon the number of times it was mentioned in the returns is expressed in the form of a per cent in the column to the right.

Table 7. Farm Practices Directed Towards the Improvement of Permanent Pastures on 92 Farms, Group A, Illinois, 1928.

Treatment	Number of times mentioned	Per cent of total
Land top dressed with manure	26	21
Woods clipped back with mower	19	16
Brush, sprouts, and briars cut	17	14
Land plowed and cropped	16	13
Wet land drained	12	10
Limestone applied	11	9
Reseeded without working	6	5
Harrowed and reseeded	5	4
Land disked in early spring	5	4
Commercial fertilizers applied	2	2
Harrowed	1	1
Land rolled	1	1
	121	100

This table is valuable so far as it goes but it shows neither the extent in acres to which each practice is used nor the thoroughness with which the work was done nor the rate of application in the case of manure and limestone. Many of these things are hard to express in quantitative terms. The table which follows gives additional information covering some of these points.

[18]Study by Dean H. W. Mumford, College of Agriculture, University of Illinois.

Table 8. Farm Practices Directed Towards the Improvement of Permanent Pastures, 6,472 Acres, 1928.

Treatment	Number of acres	Per cent of total
Brush, briars, and sprouts cut	1355	21
Weeds clipped back with mower	1241	19
Land top dressed with manure	1179	18
Land plowed and cropped	1157	18
Wet land drained	544	8
Limestone applied	298	6
Land disked in early spring	255	5
Harrowed and reseeded	156	2
Reseeded without working	98	2
Harrowed	55	1
Commercial fertilizers applied	24	x
Land rolled	10	x
	6472	100

*Less than half of one per cent.

The results of a similar study conducted among 93 farmers belonging to groups B and C are recorded below.

Table 9. Farm Practices Directed Towards the Improvement of Permanent Pastures, 93 Farms, Groups B and C, Illinois, 1928.

	Proportion of farmers reporting
Weeds clipped back with mower	30
Land top dressed with manure	24
Land disked in early spring	11
Reseeded without working	10
Harrowed	8
Land plowed and cropped	7
Land rolled	6
Limestone applied	4
	100

These farmers in no instance reported the cutting of brush sprouts and briars, the draining of wet land, harrowing and reseeding or the application of commercial fertilizers. The clipping back of weeds by means of the mowing machine, and top dressing of the land occasionally with manure, appeared to be the more common measures so far as the maintenance of permanent pasture was concerned.

THE GRAZING SYSTEM

A grazing system is a complex of three variables, namely, the time of grazing, the class or classes of stock grazed, and the intensity of stocking. Much attention has been directed toward the working out of satisfactory grazing systems in various European countries and also on the ranches of the semi-arid West. On the farms of the humid East, however, the investigation of grazing methods offers a largely untouched field for research. The present study was accomplished through the kind cooperation of teachers of vocational agriculture and their classes.

Time of Grazing. On slightly more than half of the 105 farms studied in this connection premature spring grazing was the common practice. Premature spring grazing was defined in questions in two different ways, in one inquiry it was asked whether the stock had been kept off of the pasture until the grass had made a growth of from 4 to 6 inches, and in the other whether the stock had been turned on to the pasture before the ground was firm and before the pasture had had an opportunity to make a good start. Continuous grazing was practiced on approximately 64 per cent of the farms reporting, while intermittent grazing was common on the remaining farms. Rotation grazing or systematic alternation of pasture fields was not reported from a single farm. In all but one community the fields were pastured so late in the fall and winter as to prevent the grass from making any top growth for winter protection.

Class or Classes of Stock Grazed. Pasture fields on the great majority of Illinois farms are rarely reserved for use only by classes of stock other than young stock, hogs, or sheep. Successive grazing was practiced to but a slight degree. Mixed grazing was the common system on nearly all of the farms studied. Most farmers reported simultaneous grazing by horses and cattle.

Intensity of Stocking. In all but one community heavy stocking of pasture fields was reported as the dominant practice. The farmer who stocks his pasture lightly was found only in exceptional instances. On fully half of the farms the answers indicated overstocking to be entirely too frequent. In the opinion of these farmers overstocking during certain seasons of the year was decidedly harmful on the subsequent productivity of the pastures.

RELATIVE IMPORTANCE OF THE VARIOUS CLASSES OF FARM ANIMALS IN SELECTED FARMING AREAS

In a consideration of the long time effects to be expected from any grazing system knowledge of the proportion of each class of livestock to the total number of animal units is of importance. This is because farm animals differ so widely in their effects upon pasture. Major factors accounting for this difference are peculiarities in the anatomical structure of their jaws, the presence of teeth on both jaws or on but a single jaw, the relative mobility of their lips, whether or not the lip is cleft, differences in their grazing habits (sheep and horses, for example, exercising selectivity to a high degree), the fertility value of their droppings, the age of the animal, the extent to which the particular class of stock receives feed supplementary to pasturage, effect upon the turf of the hoofs of different animals, etc. When these various factors are taken into consideration it readily becomes apparent that frequent clipping of grass with a mower does not simulate pasture conditions. Experiments in the past which have proceeded on this assumption have to be interpreted with care, otherwise they may lead to erroneous conclusions.

The proportion of each class of farm animals to the total number of animal units was studied on 343 Illinois farms for the year 1928. The findings are reported in the following table:

Table 10. Proportion of Each Class of Farm Animals to the Total Number of Animal Units, 334 Farms, Illinois, 1928.

	Group A	Group B				Group C	Group D
		McHenry County	Schuyler County	Champaign County	Effingham County		
Number of farms	49	15	16	21	14	25	194
Dairy cattle*	56	63	44	39	56	45	14
Beef cattle	4	0	0	0	0	0	23
Heifers and calves....	1	12	11	9	9	11	14
Work animals	12	14	23	36	28	27	24
Hogs	23	2	5	13	1	9	18
Pigs	0	7	15	2	5	5	4
Sheep	4	2	2	1	1	3	3
Total.....	100	100	100	100	100	100	100

*This refers only to mature dairy stock.

The table shows quite conclusively that mature dairy cattle and work animals are of major importance, with young dairy stock

and hogs come next. Beef cattle and sheep are relatively unimportant. An analysis of farmer opinion with respect to the relative severity on pastures of different classes of livestock constituted a phase of the investigation. It was found that sheep were the most severe, horses second in order of severity, dairy cows third, steers fourth, and hogs fifth. As an environmental factor in the maintenance of grasslands the grazing animal is of about equal significance to either soil or climate. Indeed, at times it may very well be of larger significance than either of these.

It is altogether likely that the vegetation of many of the best pastures on the British Isles would long ago have reverted into other forms had it not been for the stabilizing influence of the farm livestock grazing thereon. The better grades of pasture land would have given way to scrub and later to woodland, while the poorer grades would have reverted to health and moor. The ecological interaction of pasture upon stock and of stock upon pasture is a vital factor from the standpoint of animal husbandry and pasture maintenance.[19] The writer wishes to emphasize the point that its importance has not begun to be appreciated in America.

THE REPLACEMENT METHOD OF EVALUATING ECONOMIC RETURNS FROM PASTURE

During the grazing season the roughage and a portion of the concentrates in the ration of the average dairy cow are replaced by sustenance derived from pasture. A method of estimating the contribution made by pasture on dairy farms is to consider it equal to the difference between the net energy required and the net energy supplied by feeds other than pasture.[20]

These estimates rest upon the assumption that cows maintain a constant body weight throughout the year. While this is not strictly the case it is close enough for all practical purposes. Some cows gain and others lose in flesh and these fluctuations tend to balance or offset one another.

A study of 1929 records, covering 143 cow years in 11 herds, belonging to members of the Illinois Dairy Herd Improvement Association, and illustrating this method of evaluating returns of land for pasture follow:

[19]Stapledon, R. B., Fagan, T. W., and Williams, R. D., Grass Land and the Grazing Animal, University of Wales, Aberystwyth, Popular Series, H. No. 3, Seasons 1920 and 1923.

[20]Mendum, S. W. Cost of Milk Production on Forty Eight Wisconsin Farms, U. S. Department of Agriculture Bul. 1144, March 20, 1923.

Table 11. Maintenance and Production Requirements of 11 Herds, Illinois Dairy Herd Improvement Association, Illinois, 1929.*

Herd number	Number of cow years	Average body weight of cows (lbs.)	Fat test of milk %	Total amount of milk produced in year (lbs.)	Armsby Standard Requirements for: Maintenance: dig. true protein (lbs.)	Maintenance: Energy values (therms)	Production: dig. true protein (lbs.)	Production: Energy values (therms)
1	9.83	1,104	4.2	83,590	1,978.3	28,765.2	4,583.6	25,955.0
2	14.87	956	3.6	142,379	2,595.2	30,776.8	7,403.7	39,866.1
3	17.46	1,099	3.3	157,203	3,500.4	42,022.4	8,174.6	44,970.1
4	5.83	1,125	4.4	43,270	1,197.2	14,352.8	2,508.6	14,529.8
5	7.33	1,069	4.3	59,251	1,480.8	17,757.4	3,093.3	19,268.3
6	21.78	1,108	3.6	197,467	4,193.0	54,473.4	10,268.3	55,290.8
7	10.87	1,073	3.8	95,058	2,149.2	25,542.7	5,419.3	29,559.9
8	18.59	1,000	5.0	153,748	4,077.1	48,903.7	9,532.4	55,349.3
9	22.33	1,000	4.8	183,841	4,562.2	54,750.1	11,152.3	64,752.3
10	7.25	1,181	4.2	63,841	1,562.2	18,750.1	3,511.2	19,152.3
11	6.82	1,000	3.8	66,063	1,208.2	14,497.8	3,633.5	19,818.9
					27,032.2	325,864.8	64,367.1	356,108.9

*Data furnished through the courtesy of the Dairy Husbandry Department, University of Illinois.

Table 12. Maintenance and Production Requirements of 11 Herds, Belonging to Members of the Illinois Dairy Herd Improvement Association, Illinois, 1929.

	Requirements according to the Armsby Feeding Standard Digestible true protein (pounds)	Energy values (therms)
Maintenance requirements	27,032.2	325,864.8
Production requirements	64,367.1	356,108.9
Total requirements	91,399.3	681,973.7

Knowing the maintenance and production requirements of these herds for the year the next step in our study is to ascertain in what manner these requirements were met. Table 13 shows the total number of pounds of each kind of feed, with the exception of pasturage, consumed by these herds during the year, as well as their equivalent in terms of digestible true protein and therms.

Table 13. Feed Other Than Pasture Consumed by 11 Herds Belonging to Members of the Illinois Dairy Herd Improvement Association, Illinois, 1929.*

Kind of feed	Composition of feed according to the Armsby Feeding Standard. Number of pounds	Digestible true protein, (lbs.)	Energy value, (therms),
Succulent roughage:			
Corn silage	837,450	7,369.56	138,686.70
Pea vine silage	48,780	878.04	5,290.70
Dry roughage			
Timothy	28,405	582.30	9,532.70
Red clover	34,207	1,850.60	11,883.50
Alfalfa	811,230	13,867.70	68,864.10
Soybean hay	82,124	6,307.10	31,740.90
Concentrates			
Corn	129,793	8,812.94	11,473.70
Corn and cob meal	11,321	512.80	8,156.80
Oats	137,153	11,465.98	90,891.30
Barley	9,458	1,791.63	827.58
Soybeans	19,123	5,220.57	15,545.08
Linseed oil meal	3,518	968.85	2,776.39
Cotton seed meal	8,421	2,956.38	7,090.48
Bran	14,245	1,464.41	6,870.36
32% protein supplement	6,786	2,171.32	5,398.54
24% protein supplement	28,629	6,870.96	21,758.04
Unnamed protein supplement	41,233	9,071.26	36,614.90
Total number of pounds of digestible true protein and therms furnished in feed other than pasture		82,162.40	473,401.77

*Data furnished through the courtesy of the Dairy Husbandry Department, University of Illinois.

With a knowledge of the maintenance and production requirements of these herds and with a knowledge also of the quantity of digestible true protein and of therms contained in the feed other than pasture it is a comparatively simple matter to determine the sustenance furnished by pasturage. By subtracting the digestible true protein and therms in the feed other than pasture from the digestible true protein and therms required for maintenance and production a figure is obtained which may be considered as representing the contribution of pasturage.

Table 14. Digestible True Protein and Energy Value (Therms) Contributed by Pasturage, 11 Herds Belonging to the Dairy Herd Improvement Association, Illinois, 1929.

	Digestible true protein (pounds)	Energy value (therms)
Total requirements for the year	91,399.3	681,973.70
Components furnished in feeds other than pasturage during the year	82,162.4	473,401.8
Contribution of pasturage to the sustenance of 143 cows for the year	9,236.9	208,571.9
Average per cow for the year	64.5	1,458.5
Average per pasture day (basis of 20,444)	.45	10.2

The feed contribution of pasture on these farms was equal to 30.5 per cent of the net energy of all of the feed consumed by the cows in these herds. The total feed cost exclusive of pasture for the 143 cows amounted to $13,450.91 or $94.06 per cow and the charge for the use of pasture was $1,684.57 or $11.78 per cow. Pastures on these farms, while furnishing over 30 per cent of the sustenance of dairy cows, were credited with only 11.1 per cent of the total feed cost.

Assuming that a therm obtained from pasture were as costly as a similar amount of energy obtained from feed other than pasture the year's cost per cow would have been $41.18. This is equivalent to saying that, as figured, pasture was undervalued to the extent of $29.40. Instead of such a cost, however, the energy values derived from pasture were had at a computed outlay per cow of $11.78 for the year.

PROVISIONAL EXPLANATION OF THE DISPARITY BETWEEN THE REAL VALUE AND RENTAL VALUE OF PASTURES

One of the attributes of pasturage is its fixity of position with respect to time and place. It cannot be transported from regions of abundance to deficit areas and must be used, if at all, over a more or less restricted period of the year. Perhaps one of the principal reasons why they find it economically profitable to pasture high priced land on the British Isles is the long duration of the grazing season. When these things are given their due share of consideration it is easy to understand the comparatively slight fluctuation in pasture values in response to general economic conditions. Wide and violent fluctuations in the price of concentrated feeding stuffs are of not infrequent occurrences. Pasture rents are largely the result of tradition or custom and are relatively stable.

Landlords no doubt recognize the desirability from the soil fertility standpoint of having livestock on the farms which they lease out to tenants. This and the fact also that there is no competitive market for pasturage as is the case of some other products probably accounts in part for the rental value of pasturage being less than the cost of pasturage obtained through ownership. Renting of a pasture may involve some inconvenience on the part of the man who rents it. For this reason, except where the pasture is easily accessible or is to be used for young stock, dry cows, beef cattle, or other classes of farm animals requiring but little attention it may go unrented.

In cost accounting studies three methods of evaluating a farm product such as corn silage have had prominent consideration. The product may be charged to the herd of cows using it: first, at its actual cost of production; second, at its farm value (the price at the local market less the cost of marketing); or third, at the cost of its nutritive equivalent in some other feed. The fallacy in the first method of evaluation is obvious. If the herd is unable to give a return commensurate with farm value on the feed consumed the dairy enterprise had best be dropped from the farm business. In the second place, except in intensive dairy districts there is no market for corn silage. Probably as good a way as any, therefore, is the third method, that of ascertaining the cost of its nutritive equivalent. A ton of average Cornbelt silage is worth the value of 5 bushels of corn plus 300 pounds of loose hay.[21]

[21]Wallace, H. A. and Bressman, E. M., Corn and Corn Products, p. 85, 1923.

More or less parallel reasoning may be applied to the evaluation of farm pasturage. Cost of producing pasturage has been shown to run high where the alternative uses of the land in crop production are high in value. The nearest approach to selling pasturage at the market value is afforded by renting pasture land out at stated amounts of rent per acre, or at selling permission to graze animals on pasture at a stated figure per head per month.

EUROPEAN CONTRIBUTIONS TO THE PROBLEM OF PASTURE LAND MANAGEMENT

America is far behind Europe in making efficient use of her pasture resources. Whereas the joint yields of the crop land of the United Kingdom, France, and Germany are 50 per cent greater on the average as compared with the crop yields of the United States, the average productivity of the pastures of the countries of northwestern Europe is 100 per cent greater than is that of the improved pastures in the humid northeastern quarter of the United States.[22] Permanent pasture on land worth $200 per acre is profitable on the British Isles. In this country under ordinary circumstances at least the practice of keeping $200 land permanently in pasture, would be considered economically undesirable. Whether or not European methods in connection with the handling of pastures would be worthy of extensive trial by American farmers is a matter of conjecture. American agricultural experiment stations have been slow in taking up this line of investigation.

To determine, if possible, the relative significance of various factors responsible for the high average productivity of Old World pastures, letters were written to grassland experts in certain selected countries of northern and western Europe.* These men were requested to weight on a percentage basis the factors appearing on the questionnaire in accordance with their relative importance in relation to the pastures in the different countries. The results of this study are shown in Tables 15 and 16.**

[22] Gray, L. C., Baker, O. E., Marschner, F. J., Weitz, B. O., and others, The Utilization of Our Lands for Crops, Pasture and Forests, U. S. D. A. Yearbook, 1923, Separate 896.

*Material contained in this study with respect to those factors, operating in foreign countries to influence the productivity of pastures, was obtained through the cooperation of the following:

SCOTLAND: E. Wyllie Fenton, in charge of Biological Department, Edinburgh and East of Scotland College of Agriculture, Edinburgh; William Robb, Scottish Society for Research in Plant Breeding, Mid-Lothian, W. G. R. Paterson, Principal and Professor of Agriculture, The West of Scotland Agricultural College, Glasgow, Scotland.

TABLE 15. PERMANENT PASTURES

	SCOTLAND East of Scotland	Mid Lothian and East Lothian	Mid Lothian	Peebleshire	Berwickshire, Roxburghshire and Celkirkshire	Forfarshire	East Perthshire, Clackmannanshire, & Kinrosshire	West of Scotland	Fifeshire	ENGLAND Herefordshire	Devonshire	Gloucestershire	Various parts of England and Scotland	WALES Aberystwyth	IRELAND Glasnevin	GERMANY Brandenburg	Silesia
	1 %	2 %	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %	11 %	12 %	13 %	14 %	15 %	16 %	17 %
A. Factors beyond the control of man																	
1. Soil and climatic conditions favorable for the growth of grass naturally	23	36		35	30	45	17	10	33	15	....	20	35	13	40	20	5
2. Climatic or seasonal conditions unusually favorable	18	10		25	15	8	12	23	14	25	....	30	17	14	40	10	25
B. Factors susceptible to modification by man																	
3. Care in the choice of grass seeds mixtures; forage crop seeds	....	5		2	3	10	....	10	....	....	15	10	....	9	....	10	5
Use of improved varieties or strains of grasses	3	1	3rd	2	1	3	....	2	1	....	....	2	1	5	....	5	2
4. Attention to reseeding where and when necessary	....	4		3	....	....	....	5	....	1	5	3	....	8	....	5	3
5. Inoculation of seed mixtures																	
6. Fertility maintenance through the application of farm manure, limestone or commercial fertilizer	15	10	2nd	3	20	10	42	20	17	22	15	10	14	10	8	25	20
7. Cultural practices calculated to improve pasture:	4	3	3rd	2	5		4	3	5	10	10	10	4	30	2	5	10
Plowing																	
Disking																	
Harrowing																	
Others																	
8. The drainage of wet land, ditches, tiles, etc.	9	9	3rd	10	8	7	7	17	8	10	....	4	8	3	5	10	7
9. The removal of brush, sprouts, bramble, etc.	8	2	3rd	8	2	2	2	2	3	2	5	1	1	3	....	5	8
to seed, the cutting of brush, sprouts, bramble, etc.	20	20	1st	10	16	15	16	8	19	15	50	10	20	5	5	5	15
10. The systems of grazing followed	100	100		100	100	100	100	100	100	100	100	100	100	100	100	100	100

FACTORS INFLUENCING THE PRODUCTIVITY OF PASTURES IN SELECTED EUROPEAN COUNTRIES

TABLE 16. ROTATION PASTURES

	SCOTLAND East of Scotland	Mid Lothian and East Lothian	Mid Lothian	West Lothian	Berwickshire, Roxburghshire and Cokirkshire	Forfarshire (Angus)	East Perthshire, Clackmannanshire, & Kinrossshire	Fifeshire	ENGLAND Herefordshire	Devonshire	Various parts of England and Scotland	IRELAND Glanmevin	GERMANY Brandenburg	Silesia
	1 %	2 %	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %	11 %	12 %	13 %	14 %
A. Factors beyond the control of man.														
1. Soil conditions unusually favorable for the growth of grass....	20	26		20	20	25	9	19	15	10	20	24	10	7
2. Climatic or seasonal conditions unusually favorable for the growth of grass	15	8		13	10	8	5	8	25		10	23	10	24
B. Factors susceptible to modification by man.														
3. Care in the choice of grass seeds mixtures. Use of improved varieties or strains of forage crop seeds	12	13	1st	13	15	17	11	13	10	28	12	23	15	7
4. Attention to reseeding when and where necessary	....	2		7	5	2	....	4	9	....	5	2	10	7
5. Unusual care exercised in the preparation of the seed bed	12	8	2nd	7	12		10	14	1	14	12	16	10	8
6. Fertility maintenance through the application of manure, limestone or commercial fertilizer	12	14	4th	15	20	20	36	11	12	14	13	6	25	14
7. Cultural practices calculated to improve pasturage	5	4		9	5		....	10	8	10	8	2	10	....
Plowing														
Disking														
Harrowing														
Rolling														
Others														
8. The drainage of wet land	12	7	5th	5	1	7	7	2	10	....	2	....	5	9
9. The clipping back of weeds before they go to seed, the cutting of brush, sprouts, briars, etc.	....	3	5th	2	2	8	4	5	1	5	5	....	....	5
10. The systems of grazing followed	12	15	2nd	9	10	13	18	14	9	19	13	4	5	19
	100	100		100	100	100	100	100	100	100	100	100	100	100

Study of Tables 15 and 16 reveals the fact that soil conditions, seasonal influence, fertility maintenance, and the system of grazing followed are of major importance both with respect to permanent pastures and to rotation pastures. Grass seeds mixtures and care exercised in the preparation of the seed bed ranked relatively much higher in the case of rotation pastures than in the case of permanent pastures. Some good work has been done in America to determine the effect of different fertilizer treatment upon the yield of pasture lands. Leaving out of consideration the range country of the West practically nothing has been done to test out, in an experimental way, the effects of different systems of grazing upon the returns from pastures.

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**The writer sounds a word of caution in the interpretation of the contents of these tables. He is fully aware of the difficulties and dangers attendant upon any attempt to measure in an objective fashion the relative importance of the different factors, having to do with the returns to be expected from pastures. With due consideration for the limitations thus imposed, however, a study of this kind should not be without value.

APPENDIX

APPENDIX A

Table 1. Proportion of Farm Land Pastured in Illinois, the East North Central States, and the United States, and the Per Cent that Each Kind of Pasture Represents of the Total Farm Area Pastured, Census, 1910 and 1925.*

	Illinois		East North Central States		United States	
Year	1925 %	1910 %	1925 %	1910 %	1925 %	1910 %
Regular pasture:						
Permanent pasture, tillable	30	31	16	21	23	22
Permanent pasture, non-tillable	10	7	17	12	44	28
Rotated pasture, fallow land, pasture, etc.	....	....	10	5	....	....
Woods pasture	14	17	23	26	15	26
Crop land pastured:						
Aftermath pasture	9	7	10	9	5	6
Small grain stubble pasture	16	15	12	13	7	8
Corn stalk pasture	19	22	10	13	5	9
Mature corn pastured off	2	1	2	1	1	1
	100	100	100	100	100	100
Proportion of land pastured to total land in farms	45	46	47	46	54	47

*The United States Census of Agriculture reports pasture under four heads, namely, total, plowable or improved, woodland, and other. Permanent pasture inclusive both of tillable and non-tillable, was computed by taking 20 per cent of the improved land in farms. This is believed to be a very conservative estimate. The area of *other pasture* as reported by the Census was then deducted from the area of permanent pasture and the remainder considered to be representative of the amount of land in permanent pasture tillable. To find rotation pasture, fallow land pasture, etc., the figure for permanent pasture, tillable, thus obtained was subtracted from the figure reported by the Census as being in plowable or improved land pasture. Where rotated pasture is not reported in this and the following tables it is indicative that the acres in plowable or improved land pasture were fewer than those estimated to be in permanent pasture, tillable.

In this study it was assumed that one-fourth of the alfalfa acreage, one-half of the wild hay acreage, and one-third of the hay acreage other than alfalfa and wild hay furnished aftermath pasture; that one-third of the grain acreage, including corn for grain, is annually pastured after harvest; and that 2.4 per cent of the corn for grain acreage is pastured off by livestock. For the year 1910 it was estimated that about one per cent of the corn for grain was pastured off. In farming-type Area 3 of western Illinois it was thought a conservative figure for the amount of corn for grain disposed of in this fashion was eight per cent. This accordingly was the figure used in our calculations for 1925.

Table 2. Percentage of All Land Grazed in Various Pasture Uses as Computed or as Estimated, Census 1910 and 1925.

	Illinois		Four County Area*		Farming-Type Area 4. 20 Counties	
Year	1925	1910	1925	1910	1925	1910
	%	%	%	%	%	%
Regular pasture:						
Permanent pasture, tillable	30	31	23	22	17	40
Permanent pasture, non-tillable	10	7	4	3	4	1
Rotated pasture	....	....	....	....	8	....
Woods pasture	14	17	11	13	9	2
Crop land pastured:						
Aftermath pasture	9	7	4	5	5	5
Small grain stubble pasture	16	14	25	23	25	20
Corn stalk pasture	19	22	31	33	30	30
Mature corn pastured off	2	2	2	1	2	2
	100	100	100	100	100	100
Proportion of land pastured to all farm land	45	46	42	43	42	46

*Referring to the counties of Woodford, Tazewell, McLean, and Livingston.

Table 3. Apportionment of Pasture Land Among Each of of Its Several Kinds, By Farming-Type Areas, Illinois, Census Data, 1925.

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
	%	%	%	%	%	%	%	%
Regular pasture:								
Permanent pasure, tillable	28	16	18	17	37	15	32	35
Permanent pasture, non-tilltble	14	19	16	4	4	10	11	7
Rotated pasture	1	10	6	8	....	....	....	10
Woods pasture	15	15	19	9	12	12	12	11
Crop land pastured:								
Aftermath pasture	13	8	6	5	10	39	10	15
Small grain stubble	19	15	14	25	12	11	23	8
Cornstalk pasture	9	15	17	30	23	12	11	13
Mature corn pastured off	1	1	4	2	2	1	1	1
	100	100	100	100	100	100	100	100
Proportion of all farm land pastured	41	48	50	42	46	69	41	41

Table 4. Apportionment of Pasture Land Among Each of Its Several Kinds, By Farming-Type Areas, Illinois, Census Data, 1910.

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
	%	%	%	%	%	%	%	%
Regular pasture:								
Permanent pasure, tillable	18	19	27	40	37	30	28	39
Permanent pasture, non-tillable	16	14	8	1	3	5	11	4
Rotated pasture	6	9	....	....	....	....	....	....
Woods pasture	18	18	22	2	14	22	14	18
Crop land pastured:								
Aftermath pasture	13	9	6	5	5	5	7	8
Grain stubble pasture	13	12	12	20	13	14	23	10
Corn stalk pasture	15	18	20	30	26	22	16	20
Mature corn pastured off	1	1	5	2	2	2	1	1
	100	100	100	100	100	100	100	100
Proportion of all farm land pastured	48	51	50	46	45	47	44	39

VITA

James Putnam George was born in Odell, Livingston County, Illinois, August 8, 1893. He was graduated from Jefferson High School at LaFayette, Indiana, in 1912. Higher institutions of learning attended during his career first as an under-graduate and later as a graduate student include Purdue University, Iowa State College of Agriculture and Mechanic Arts, Cornell University, and the University of Illinois. The B.S. degree in animal husbandry was conferred upon him from Iowa State College in 1918, the M.S. degree in agriculture from Cornell University in 1925, and the Ph.D. degree in economics from the University of Illinois in 1930. Major emphasis in graduate study was placed upon agricultural economics, agronomy, and rural education. According to the definition given by the United States Census of Agriculture his farm residence extended over not fewer than six years. Nine years were devoted to the teaching of vocational agriculture in secondary schools, part of which time Mr. George had the additional responsibility of the principalship of a rural high school. While the World War was in progress he enlisted in the Canadian Expeditionary Forces. Upon his discharge from the service he resumed his duties as a teacher in the field of vocational education. Following the completion of the work for the Master's degree in agriculture at Cornell University he was on the staff of the New York State School of Agriculture at Morrisville, New York, where he was in charge of farm management and agronomy. He is a member of the Grange, and of the Masonic and Phi Delta Kappa fraternities.

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TITLE